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and we have no evidence that they were ever more abundant or widely distributed. No one believes that the Indians originated in the region now inhabited by the poisonous lizards.

One who has seen young children playing with snakes, even with rattlesnakes, may well be skeptical about an instinctive horror of serpents. Mothers in some regions have found it advisable to deliberately teach their children to fear snakes, in order to prevent them from handling the dangerous species. In other cases the fear probably comes from association with those who had acquired the serpent horror. On the other hand there are many boys and men, and some women, who seem to be quite devoid of any such horror. The argument that one unexpectedly brought into close proximity to any kind of a snake "is suddenly seized with a panic of horror and fear," has very little weight, because it is not universally so and the same is usually the case when one is brought suddenly into close proximity with almost any kind of an animal. Does woman's proverbial fear of a mouse indicate an instinct engendered by ancestral residence in a region where such small animals were dangerous? Many beginners in biology exhibit as much horror of a worm or a caterpillar, in proportion to its size, as of a serpent.

The "instinctive horror of serpents" does not appear to be established by satisfactory evidence.

JUNIUS HENDERSON

TO THE EDITOR OF SCIENCE: Mr. Dabney's very interesting letter in SCIENCE for January 7, 1916, leads me to inquire: if the fear of snakes, by man, is an indication that there were many snakes surrounding him in primitive days, what does the fear of Indians by the American mule indicate? Was the mule developed in a region where he was surrounded by wicked Indians who abused him?

Frémont mentions this abnormal fear of Indians on the part of our ordinary mules and it has been noted by others, including myself. Frémont says:

A mule is a good sentinel, and when he quits eating and stands with his ears stuck straight out taking notice it is best to see what is the matter.

For my part I noticed that our mules were as good as or better than most watch-dogs in giving warning of the near presence of Indians. Often before Indians were either seen or heard by any of our party the mules would snort with terror, halt, shy about, and "point" in the direction of the Indian with ears sharply bent forward and a general activity that might land a poor rider on his head. Now, why was the mule so much more afraid of Indians than horses were? I do not remember any of our horses being in the least frightened. Perhaps it was the smell of the Indian the mule detected, for their scent is very keen, but if it was the scent, why did the scent disturb them?

When we had Indians travelling with us, as was frequently the case, the mules became accustomed to their presence and were apparently unmindful of them, yet when an Indian was assigned to ride a mule there was a circus at once and it took half the camp to get him on. Once on, however, the mule being always a mighty wise being, ceased his antics and was calm as a kitten till the Indian got off and tried to remount, when we had the circus all over again. No human being can fathom the wisdom of the mule, of that I am positive, but possibly some reader of SCIENCE may be able to explain the mule's fear of Indians by some other hypothesis than that the Indian was cruel to him in the mule's original, primitive, habitat. Finally, if the fear of snakes designates the location of our primitive home where was the primitive home of the mule reasoning from his fear of Indians?

F. S. DELLENBAUGH

NEW YORK

#### SCIENTIFIC BOOKS

*Robert of Chester's Latin Translation of the Algebra of Al-Khowarizmi, with an Introduction, Critical Notes, and an English Version.* By LOUIS CHARLES KARPINSKI, University of Michigan Studies, Humanistic Series, Vol. XI. New York, The Macmillan Company, 1915. Pp. viii + 164. Price \$2. In mathematics, as in art, letters, religion,

and the other domains of human activity, there are a few great classics which stand out as monuments to the world's progress. Such are the "Elements" of Euclid, the work of Apollonius on conics, the "Arithmetic" of Diophantus, "La Géométrie" of Descartes, and others of their kind, works upon which rest the great structure of modern mathematics. Among these classics stands and must always stand the first work which bore the name of algebra, the *algebr w'al muquabala* of Al-Khowarizmi, a scholar working at the court of the caliphs at Bagdad although bearing the name of his native state, Kharezmi, the country about the modern Khiva. This treatise was written about the year 825 of our era, and although the world had an algebra of one kind or another for many centuries before the era of the "Arabian Nights Tales," it was Al-Khowarizmi who first set forth the science in a treatise bearing the name with which we are familiar.

Like so many Arab productions, the works of Al-Khorwarizmi attracted the attention of scholars in that remarkable period of the awakening of Europe from a long intellectual slumber, the twelfth century. First there was his arithmetic, which was translated by John of Seville as the "Liber algorismi" (Book of Al-Khowarizmi), a title from which we have such words as *algorism* (algorithm) and *augrim*. This work did much to make the Hindu-Arabic numerals known in Europe, and to it is due the name given to the algorists (*algoristi*), those who computed by these numerals instead of using the medieval counters. In the nature of things, the algebra was a less popular work, although it was more or less familiar to scholars from and after the middle of the twelfth century. Of the translators who assisted in making known the science of the Arabs to the scholars of the West, Gherardo of Cremona and Robertus Cestrensis (Robert of Chester) are among the best known, and each appears to have translated the algebra of Al-Khowarizmi. There seems also to have been another translator of this work, not to speak of Leonardo Fibonacci who has a chapter upon "Aljebra et almuchabala" in his "Liber

abaci" (1202). This translator was William of Luna, and it is possible, as Professor Karpinski points out, that it is his version which was found by this reviewer some years ago in a manuscript in the library of George A. Plimpton, Esq., of New York.

Of these translations one had appeared in print before Professor Karpinski undertook his work. This is the translation attributed to Gherardo of Cremona, published about eighty years ago in the appendix to Libri's "Histoire des sciences mathématiques." Robert of Chester's translation, which has now been made available for us, had been described by Wappler from two codices (Dresden and Vienna), but only these two copies had come to light until the present writer happened upon a third one about a dozen years ago and purchased it for the Columbia University Library. This last-mentioned codex turned out to be in the handwriting of Johann Scheybl, a Tübingen professor who lived in the first three quarters of the sixteenth century. It is this manuscript which Professor Karpinski has translated and annotated with rare pains and with a scholarship which is very gratifying to American workers in this field.

The arrangement of the material is very convenient. The original work, transcribed with care, appears upon the left-hand page while a translation faces it from the opposite page, thus making it possible to compare the two with a minimum of trouble. At the foot of each page of text are notes relating to such matters as the variants in the three codices, while at the foot of each page of translation are notes explanatory of the text. We have nowhere a translation of a mathematical work in any language that is so conveniently arranged.

The task which Professor Karpinski set for himself was not an easy one. Scheybl wrote a hand which looks legible at first sight but which is difficult to read, as witness the facsimile inserted in this edition. Indeed it was no doubt due to the very fact that the handwriting was so illegible that we owe its acquisition by Columbia, since otherwise its value would have been recognized many years

ago. To be sure there was the Libri transcription of the translation attributed to Gherardo to help in reading the manuscript, and there was Rosen's translation from the Arabic (1831), but neither of these has the same wording, and neither could render much assistance in the difficult task.

The translation can best be described by the word sensible. It is fortunately not literal, for a literal translation of, say, "*substantiæ radices cœquant*" or "*De substantia et drachmis res cœquantibus*" would be unintelligible. Even such an expression as "*et etiam si dicas*" is better rendered by "another example" than by a verbatim translation. To be sure this freedom leads to inconsistencies, as when "*Tria igitur huius substantiæ sunt radix; et substantia nouem*" appears as "Therefore three (spelled) is the root of this  $x^2$  (symbol), and  $x^2$  is 9 (symbol)"; while the sentence "*Substantia et 21 drachmæ 10 rebus æquiparantur,*" which follows, appears as "A square (word) and 21 units are equal to ten (spelled) unknowns" instead of, say, " $x^2 + 21 = 10x$ ." These variations in style are not at all confusing, however, because the student always has the original on the facing page.

The style of the problems of Al-Khowarizmi shows the Greek influence, that is, the questions are generally abstract; for example, "From a square I subtract three of its roots and multiply the remainder by itself; the sum total of this multiplication equals the square"; or, in the shorthand of modern algebra,  $(x^2 - 3x)^2 = x^2$ . There are, however, a few questions in the rule of three, apparently a product of the Orient, but all are so simple as to deserve no place in algebra.

Al-Khowarizmi can not be said to have made any discovery in algebra. He was essentially a compiler of problems which he solved by methods already known. He invented no symbolism as Diophantus apparently did, nor did he show the remarkable genius of this last great representative of the dying mathematics of a dying Greek civilization. He contributed nothing to the solution of the quadratic that the Alexandrian school had not known, and

even the special cases of the cubic equation were as a sealed book to him. His problems lack the delicious imagery to be found in the Hindu schools of his time, and the same is true, oddly enough, of those of the great Persian algebraist and poet Omar Khayyam.

Whatever may be said, however, of the details of the work itself, it is evident that Al-Khowarizmi will always occupy a prominent place in the history of mathematics, and that Dr. Karpinski's publication will rank as the first noteworthy effort in our country in the editing of a renaissance manuscript on the subject of algebra. The thanks of all scholars are due to him for his careful work and to the University of Michigan for publishing the result in such a satisfactory style.

DAVID EUGENE SMITH

*Fungoid Diseases.* An English-American Book. London, Longmans, Green and Co. 118 pp. Price 65c.

The latest book on fungi to come to hand is a pleasing little volume by Thomas Milburn and E. A. Bessey, entitled "*Fungoid Diseases of Farm and Garden Crops.*" The title betrays its English origin, for if written in America it would have been called "*Fungous Diseases*" or perhaps by a select few "*Fungus Diseases.*" The English have not the reputation of being so far advanced as Americans in the application of remedies for fungous diseases, yet when it comes to writing general semi-popular books on the nature of fungi they lead them by many volumes, as represented by those published by Berkeley, Smith, Cooke and Massee.

The volume under consideration, more than any of its English predecessors, puts stress on practical treatment. As partially indicated by the title, it does not discuss the diseases of fruits, but rather those of cereals, legumes, root crops and certain vegetables, with a short chapter on fungoid diseases of animals. This limits its usefulness for a wide class of readers, especially in this country. The descriptions are popular, followed in each case by a paragraph on preventive measures. The book was written "primarily for the use of farmers,